

improvement strategy. A joint approach to organizational and job design will not only result in decreased prevalence of health risks, but in enhanced organizational effectiveness as well. The implementation of the WCM, that is, the Work Compatibility Improvement Framework, provides the basis for integrating different elements of the work environment into a single reliable construct. An improvement framework is essential to ensure that the measures of the WCM result in a system that is adaptive and self-regulated.

- **Keywords:** Human-at work; System compatibility; Work environment; Job design

Yassierli,; Nussbaum, Maury A.; Iridiastadi, Hardianto; Wojcik, Laura A. *The influence of age on isometric endurance and fatigue is muscle dependent : a study of shoulder abduction and torso extension. S. 26-45(20).*

Abstract: The present study examined differences in isometric muscle capacity between older (55-65 years) and younger (18-25 years) individuals. A total of 24 younger and 24 older participants (gender balanced within each group) performed sustained shoulder abductions and torso extensions to exhaustion at 30%, 50% and 70% of individual maximal voluntary contraction (MVC). Along with endurance time, manifestations of localized fatigue were determined based on changes in surface electromyographic signals obtained from the shoulder (middle deltoid) and the torso (multifidus and longissimus thoracis) muscles. Strength recovery was monitored using post-fatigue MVCs over a 15-min period. Compared to the younger group, older individuals exhibited lower muscular strength, longer endurance time and slower development of local fatigue. Age effects on fatigue were typically moderated by effort level, while effects of gender appeared to be marginal. Non-linear relationships between target joint torque and endurance time were observed, with effects of age differing between shoulder abduction and torso extension. Overall, the effects of age on endurance and fatigue were more substantial and more consistent for the shoulder muscle than for the torso muscles and were likely related to differences in muscle fibre type composition. For strength recovery rates, no significant age or gender effects were found in either experiment. In summary, this study suggests that differences in isometric work capacity do exist between older and younger individuals, but that this effect is influenced by effort level and the muscle tested.

- **Keywords:** Aging; Isometric exercise; Muscle fatigue; Muscle endurance; Strength recovery

Young, Mark S.; Stanton, Neville A. *Back to the future : brake reaction times for manual and automated vehicles. S. 46-58(13).*

Abstract: Rear-end collisions are often quoted as being a major cause of road traffic accidents. In response to this, a great deal of ergonomics research effort has been directed towards the analysis of brake reaction times. However, the engineering solution has been to develop advanced systems for longitudinal control, which, it is argued, will mitigate the problem of rear-end collisions. So far, though, there have been few empirical studies to determine how brake reaction times will be affected by such vehicle automation. This paper presents a literature review summarizing the current state of knowledge about driver responses in non-automated vehicles. The review covers driver factors, vehicle factors and situational factors. Following the review, some empirical data are presented from a driving simulator experiment assessing brake reaction times of skilled and unskilled drivers under two different levels of automation. When compared to previous data gathered during manual driving, there seems to be a striking increase in reaction times for these automated conditions. Implications for the design and safety of automated vehicle systems are discussed.

- **Keywords:** Automation; Brake reaction time; Driving; Skill

Leclercq, S.; Thouy, S.; Rossignol, E. *Progress in understanding processes underlying occupational accidents on the level based on case studies. S. 59-79(21).*

Abstract: The purpose of this work was to further the knowledge of contexts surrounding accidents on the level in occupational situations with a view to proposing suitable actions for the prevention of these accidents. The study, undertaken at three establishments belonging to a national rail transport company, was based on quantitative and qualitative analysis of accident-on-the-level data available at the establishments concerned, typology of these accidents, interviews with victims and activity analysis. Understanding accidents on the level through building scenarios makes it possible to consider the relevance of prevention actions, such as workplace or environmental design/remediation and machine access system design. Moreover, it also makes it possible to consider curtailing the injury-causing aspect of the physical environment by reducing its aggressivenessTM. Finally, the prospects emerging from this work in the research field are discussed.

- **Keywords:** Injury prevention; Occupational accident; Accident on the level; Balance

Bruce-Low, S. S.; Cotterrell, D.; Jones, G. E. *Effect of wearing personal protective clothing and self-contained breathing apparatus on heart rate, temperature and oxygen consumption during stepping exercise and live fire training exercises. S. 80-98(19).*

Abstract: Fire fighter breathing apparatus instructors (BAIs) must possess the ability to respond to both the extrinsic stress of a high temperature environment and the intrinsic stress from wearing personal protective equipment (PPE) and self-contained breathing apparatus (SCBA), repeatedly and regularly, whilst training recruits in live fire training exercises (LFTes). There are few previous investigations on BAIs in hot environments such as LFTes, since the main research focus has been on regular fire fighters undertaking exercises in temperate or fire conditions at a moderate to high exercise intensity. In this study, the intrinsic cardiovascular stress effects of wearing PPE+SCBA were first investigated using a step test whilst wearing gym kit (control), weighted gym kit (a rucksack weighted to the equivalent of PPE+SCBA) and full PPE+SCBA (weight plus the effects of protective clothing). The extrinsic effects of the very hot environment were investigated in BAIs in LFTes compared to mock fire training exercises (MFTes), where the fire was not ignited. There was an increase in heart rate due to the modest workload imposed on the BAIs through carrying out the MFTes (25.0 (18.7)%) compared to resting. However, when exposed to fire during the LFTes, heat storage appears to be significant as the heart rate increased by up to 39.8 (± 20.1)% over that of the mock LFTes at temperate conditions. Thus, being able to dissipate heat from the PPE is particularly important in reducing the cardiovascular responses for BAIs during LFTes.

- **Keywords:** Training; Instructors; Protective clothing; Exercise; Oxygen cost

Murata, Atsuo; Moriwaka, Makoto. *Applicability of location compatibility to the arrangement of display and control in human-vehicle systems : comparison between young and older adults. S. 99-111(13).*

Abstract: The effects of age on applicability of the location compatibility principle to the design of display and control systems were discussed. A dual-task experiment was conducted, in which the primary task was first-order tracking. The secondary tasks included control of an air conditioner, the operation of a radio and the operation of a CD/MD, by means of either a steering wheel-mounted switch or a console-mounted switch. The display was arranged either in front of or on the left side of a participant.

Performance of the young group did not completely follow predictions of the compatibility principle. In particular, the principle did not apply to the left-side display condition. The steering wheel-mounted switch was more effective than the left-side switch even for the left-side display. The compatibility principle was applicable to both front and left-side displays for the older adults. For the front display, the steering wheel-mounted switch was more effective. Such differences should be taken into account when designing display and control systems in man-vehicle systems.

- **Keywords:** Steering wheel mounted control; Location compatibility; Tracking; Dual task; Man-vehicle system; Aging

Xu, Xidong; Wickens, Christopher D.; Rantanen, Esa M. *Effects of conflict alerting system reliability and task difficulty on pilots' conflict detection with cockpit display of traffic information. S. 112-130(19).*

Abstract: A total of 24 pilots viewed dynamic encounters between their own aircraft and an intruder aircraft on a 2-D cockpit display of traffic information (CDTI) and estimated the point and time of closest approach. A three-level alerting system provided a correct categorical estimate of the projected miss distance on 83% of the trials. The remaining 17% of alerts were equally divided between misses and false alarms, of large and small magnitude. Roughly half the pilots depended on automation to improve estimation of miss distance relative to the baseline pilots, who viewed identical trials without the aid of automated alerts. Moreover, they did so more on the more difficult traffic trials resulting in improved performance on the 83% correct automation trials without causing harm on the 17% automation-error trials, compared to the baseline group. The automated alerts appeared to lead pilots to inspect the raw data more closely. While assisting the accurate prediction of miss distance, the automation led to an underestimate of the time remaining until the point of closest approach. The results point to the benefits of even imperfect automation in the strategic alerts characteristic of the CDTI, at least as long as this reliability remains high (above 80%).

- **Keywords:** Cockpit display of traffic information; Conflict detection; Multi-level alert system; Automation reliability; Automation dependence

Rajput, B.; Abboud, R. J. *The inadequate effect of automobile seating on foot posture and callus development. S. 131-137(7).*

Abstract: Driver posture is an important factor to be considered in the ergonomics design process of automobiles. Most decisions during automobile design and manufacture are informed by studying the intricate biomechanical components of human musculoskeletal systems to ensure maximum comfort, safety and well-being during driving. A case study is presented that confirms inappropriate foot position as a causative factor for the development of abnormal lateral/plantar heel callosities when driving a 4-wheel style vehicle. The driver's foot position was influenced by the seat geometry of the vehicle. Cessation of driving the 4-wheel style vehicle and driving of an alternative automobile while on holiday for a period of 4 weeks resolved the condition. On return to the 4-wheel style vehicle, however, the abnormal callus patterns redeveloped while using the same footwear and no change in any other parameters. It is therefore suggested that seat and consequent foot position is an important ergonomic factor that should be addressed in the future design of automobile seating.

- **Keywords:** Automobiles; Callus; Driving ergonomics; Foot posture; Seating

Winter, J. C. F. de; Wieringa, P. A.; Kuipers, J.; Mulder, J. A.; Mulder, M. *Violations and errors during simulation-based driver training. S. 138-158(21).*

Abstract: The effectiveness of virtual driving instruction can increase when techniques that automatically distinguish between violations and errors are available, two behaviours requiring different types of remediation. This study reports the analysis of the objectively measured performance of 520 participants completing a simulation-based training programme. Factor analysis of failure reasons showed that violations and errors were the primary underlying factors. Men committed more violations and women made more errors; the magnitude of sex differences corresponded to the factor loadings. Factor analysis of the mean task completion times yielded a factor that can be described as the extent to which motivation for speed resulted in quicker task execution. Quicker participants completed more tasks, committed more violations, but made fewer errors. Participants reduced errors during forced-paced driving and increased speed during self-paced driving. The authors would recommend exploiting the distinction between violations and errors by developing interfaces and feedback for both types of aberration.

- **Keywords:** Human violations and errors; Driving simulator; Driver training